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Concepts for intuitive and abbreviated planning procedures

David J. Bryant

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Abstract

This report examines the applicability of the Intuitive or Naturalistic Decision Making (NDM) approach as a framework for developing a military planning process that is easier to perform, more effective, and more consistent with natural human reasoning capabilities than existing analytic approaches. Theories of intuitive decision making are considered because they can inform how people solve complex problems or plan operations in natural settings and serve as a link between planning and decision making in the field. Based on previous models and experimental studies of naturalistic decision making, this report reviews concepts and procedures to support more efficient intuitive planning. This report discusses eleven specific concepts that should be considered in development of an abbreviated, intuitive planning process. This report also presents a prototype process to serve as a framework in which to consider how intuitive planning concepts might be synthesized with existing planning procedures.

Résumé

Il s’agit ici de déterminer si l’application d’un cadre décisionnel intuitif ou naturaliste permettrait de mettre au point un processus de planification plus simple, plus efficace et plus conforme aux capacités naturelles de raisonnement de l’être humain que les approches analytiques qui existent déjà dans un contexte militaire. Si l’on envisage de recourir aux théories de la prise de décision intuitive, c’est parce qu’elles peuvent jeter un éclairage sur la façon de résoudre des problèmes complexes ou de planifier des opérations dans des contextes naturels. Elles peuvent aussi servir de lien entre la planification et la prise de décision sur le terrain. Le présent rapport passe en revue les concepts et les démarches relatifs à la prise de décision naturaliste en se fondant sur des modèles et des études expérimentales qui existent en la matière en vue de promouvoir une planification intuitive plus efficace. Il examine onze concepts qui devraient être pris en considération lors de l’élaboration d’un processus simplifié de planification intuitive. De plus, il présente un prototype de processus qui servira de cadre de réflexion sur la façon d’intégrer les concepts de la planification intuitive aux mécanismes de planification en place.

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Executive summary

This report examines scientific and military literatures to identify deficiencies with the current doctrinal approach to planning. Evidence suggests that the Intuitive or Naturalistic Decision Making (NDM) approach could be a framework for developing a new military planning process that is easier to perform, more effective, and more consistent with natural human reasoning capabilities than existing analytic approaches. This report examines arguments for an NDM approach to planning and identifies a set of concepts that may be useful for enhancing the planning process.

Although the analytic approach to problem solving, as embodied in the Operations Planning Process (OPP), has been widely adopted, procedural and human cognitive constraints suggest the approach is not ideally suited to military planning. Analytic processes like the OPP have fairly severe practical boundary conditions that limit their applicability to complex, real-world domains. Analytic processes are also at odds with natural human decision making and impose obstacles to the effective use of expertise.

In contrast, intuitive, or NDM, theories, are based not on formal analyses but strategies that experienced decision makers actually use. NDM theories generally emphasize recognitional and pattern matching processes. The major principle is that the decision maker attempts to recognize the current situation and match it to a Course of Action (COA) or solution that has previously been encountered. Empirical evidence supports the NDM approach for decision making in the military domain. Studies examining the impact of constraints on decision making have suggested people act in accord with NDM because the demands of most real-life problems exceed their memory and attentional capabilities. Intuitive theories involve less computation and make use of more automatic processes than analytic theories.

It is worth considering theories of intuitive decision making in the context of operational planning for two reasons. First, the planning process is intended to serve as a bridge between preparation for an operation and actual decision making in the field. Thus, there should be a meaningful link between how the commander and staff plan the operation, and the products they produce, with the ways people naturally think and decide while conducting the operation. Second, there is extensive overlap among decision making, problem solving, and planning that renders a strict distinction among them of little use. Theories of intuitive decision making extend to solving complex problems and planning operations in natural settings. Studies examining military planning have found that expert teams not only deviate from the prescriptions of the analytic planning process but also spontaneously shift into processes consistent with intuitive decision making. Several researchers have developed planning processes that incorporate various concepts of intuitive decision making.

Based on previous models and experimental studies of naturalistic decision making, this report reviews concepts and procedures to support more efficient and effective intuitive planning. COAs and contingencies derived through an analytic process such as the OPP may not be entirely consistent with the kinds of decision making processes commanders are likely to employ as the operation unfolds. When time is very limited and information not readily available, as is most often true during operations, commanders generally rely on their capability

to rapidly assess the situation and immediately understand what to do. Thus, the planning procedure should be aimed, at least in part, at supporting this sort of decision making.

Based on general lessons-learned and theories of problem solving, it is possible to draw a number of specific planning concepts for consideration. This report discusses eleven specific concepts that should be considered in development of an abbreviated, intuitive planning process that takes advantage of natural human decision processes. These concepts are:

- Perform fewer stages;
- Pursue a single COA;
- Perform less factorial analysis and more wholistic evaluation;
- Ensure the process is commander-driven, especially COA development;
- Select a single COA to pursue early in the process;
- Perform explicit analysis of assumptions;
- Create a plan to assess the success of the plan;
- Create a common conceptual model (visualization) of the plan;
- Wargame to synchronize the plan not evaluate the COA;
- Emphasize critical thinking and evaluation; and
- Increase emphasis in training on experiential learning.

The proposed concepts can form the basis of an abbreviated planning process based on the premises of intuitive decision making theory. This report presents a prototype of such a process. Although not intended to be a complete planning process, the prototype can serve as a framework in which to consider how the proposed concepts might be synthesized.

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Sommaire

Le présent rapport passe en revue les ouvrages scientifiques et militaires dans le but de repérer les lacunes que présente l'actuelle démarche doctrinaire appliquée au processus de planification. D'après les éléments de preuve dégagés par cet examen, on pourrait recourir à une approche intuitive ou naturaliste en matière de prise de décision pour élaborer un nouveau processus de planification plus simple, plus efficace et plus conforme aux capacités naturelles de raisonnement de l'être humain que les approches analytiques existantes, dans un contexte militaire. Le rapport examine les arguments en faveur de l'adoption d'une démarche décisionnelle intuitive en planification et expose une série de concepts qui pourraient servir à optimiser le processus de planification.

Même si la démarche analytique en matière de résolution de problèmes, qui caractérise le Processus de planification opérationnelle (PPO), a été largement adoptée, elle n'est pas parfaitement adaptée à la planification militaire en raison de contraintes liées à la procédure et à la capacité cognitive humaine. Les démarches analytiques, telles que le PPO, comportent des conditions aux limites assez graves sur le plan pratique, qui restreignent leur applicabilité à des situations complexes et réelles. De plus, les démarches analytiques sont incompatibles avec le processus naturel de prise de décision chez l'être humain et dressent des obstacles à une exploitation efficace de l'expertise.

Par contre, les théories de la prise de décision intuitive sont fondées non pas sur des analyses formelles, mais sur des stratégies réellement employées par des décideurs chevronnés. Elles tablent généralement sur la reconnaissance et l'appariement des structures, l'idée étant que le décideur tente de reconnaître la situation actuelle et de l'apparier à un plan d'action ou à une solution qui existe déjà. Les données empiriques militent en faveur de l'adoption d'une démarche intuitive en matière de prise de décision dans le contexte militaire. Des études concernant les effets des contraintes sur la prise de décision indiquent que les gens se laissent guider par une approche intuitive parce que les exigences de la plupart des problèmes réels dépassent leurs capacités de mémoire et d'attention. Par rapport aux théories analytiques, les théories intuitives impliquent moins de calcul et font appel à des mécanismes plus automatiques.

Deux raisons expliquent que le recours aux théories de la prise de décision intuitive dans le contexte de la planification opérationnelle mérite d'être envisagé. Premièrement, le processus de planification est censé servir de trait d'union entre la phase préparatoire d'une opération et la prise de décision proprement dite sur le terrain. Autrement dit, il devrait donc y avoir un lien significatif entre la façon dont le commandant et le personnel planifient l'opération, et les produits ainsi générés, d'une part, et la façon dont les gens réfléchissent et décident naturellement au cours d'une opération, d'autre part. Deuxièmement, il y a tellement de chevauchement entre la prise de décision, la résolution de problèmes et la planification qu'il est presque inutile d'établir une distinction rigoureuse entre ces trois processus. Les théories de la prise de décision intuitive s'étendent jusqu'à la résolution de problèmes complexes ou la planification des opérations dans des contextes naturels. Il ressort d'études sur la planification dans un contexte militaire que non seulement les équipes d'experts s'écartent des principes dictés par la planification analytique, mais elles se tournent aussi spontanément vers des façons

de faire conformes à la prise de décision intuitive. Plusieurs chercheurs ont élaboré des processus de planification qui intègrent divers concepts de la prise de décision intuitive.

Le présent rapport passe en revue les concepts et les démarches relatifs à la prise de décision naturaliste en se fondant sur des modèles et des études expérimentales qui existent en la matière en vue de promouvoir une planification intuitive plus efficace. Les plans d'action et situations hypothétiques qui découlent de l'application d'un processus analytique, comme le PPO, ne sont pas nécessairement parfaitement conformes aux types de processus de décision que les commandants emploieraient lorsque l'opération se déploie. Lorsqu'on dispose de très peu de temps et que l'information n'est pas facilement accessible, comme c'est très souvent le cas lors des opérations, les commandants se fient généralement à leur capacité d'évaluer rapidement la situation et de comprendre sur-le-champ ce qu'il convient de faire. Ainsi, la méthode de planification devrait viser, du moins en partie, à faciliter ce type de prise de décision.

Il est possible, à la lumière des leçons générales acquises et des théories relatives à la résolution de problèmes, de dégager un certain nombre de concepts spécifiquement liés à la planification, en vue de les étudier. Le présent rapport analyse onze concepts qui devraient être pris en considération lors de l'élaboration d'un processus simplifié de planification intuitive qui tire parti des processus de décision naturels de l'être humain, à savoir :

- Prévoir moins d'étapes;
- Retenir un seul plan d'action;
- Mettre davantage l'accent sur l'évaluation holistique que sur l'analyse factorielle;
- Veiller à ce que le processus, surtout l'élaboration de plans d'action, soit piloté par un commandant;
- Choisir, au début du processus, un seul plan d'action à suivre;
- Procéder à une analyse explicite des hypothèses;
- Établir un plan d'évaluation de la réussite du plan;
- Créer un modèle conceptuel commun (visualisation) du plan;
- Faire en sorte que le jeu de guerre vise à synchroniser le plan, pas à évaluer le plan d'action;
- Mettre l'emphase sur l'évaluation et la pensée critiques;
- Insister davantage sur la formation en apprentissage par l'expérience

Les concepts proposés peuvent jeter les bases d'un processus de planification simplifié, fondé sur les prémisses de la prise de décision intuitive. Un prototype de processus de ce genre est présenté ici. Même s'il ne prétend pas être un processus de planification complet, le prototype peut servir de cadre de réflexion sur la façon de synthétiser les concepts proposés.

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Introduction

Background

Armies have always fought under conditions of uncertainty and commanders have always struggled to find ways to deal with that uncertainty. A plan is a way to cope with uncertainty but concepts of what constitutes a plan and how best to devise one have been mutable over the centuries. Canadian Forces (CF) doctrine [1] proscribes a process meant to aid commanders and their staffs in developing good plans, the Operations Planning Process (OPP). This report examines scientific and military literatures to identify deficiencies with the current doctrinal approach to planning. Evidence suggests that alternative approaches, such as Naturalistic Decision Making (NDM) [2] [3] [4], hold some promise as frameworks for developing a new military planning process that is easier to perform, more effective, and more consistent with natural human reasoning capabilities than existing analytic approaches. This report examines arguments for an NDM approach to planning and identifies a set of concepts that may be useful for enhancing the planning process.

Canadian Forces doctrine

The OPP is a structured procedure for planning military operations and making decisions concerning the conduct of an operation once it has begun. The OPP is laid out in CF doctrine [1] and overlaps to some extent with The Estimate and Battle Planning, which are other planning procedures used by the Land Force (LF) [5]. The Estimate is the process by which a commander performs mission analysis, evaluates relevant factors, considers possible Courses of Action (COAs), and selects a COA that is suitable to meet mission objectives. The OPP comprises all the steps of The Estimate and includes three others – an initiation step in which missions and tasks are received, plan development, and plan review. The six main steps of the OPP are listed in Table 1. The OPP can be described as a series of steps, but it is intended to be a highly iterative process to cope with the nonlinear nature of operations [6].

These steps are briefly described here but Bryun et al. [5] provide a more complete description as well as a diagrammatic representation.

Direction from higher command initiates the first step of Receipt of Tasks. On receipt of tasks, the Chief of Staff (COS) of G3 (General Staff 3, responsible for operations) issues a warning order and all staff branches begin gathering data for the operation.

The next step, Orientation, begins with an analysis of the mission performed by the commander with his/her staff. The analysis identifies critical factors and results in a tentative Concept of Operations (CONOPS) to guide further planning. The commander provides initial versions of the mission statement, the commander’s intent, and the CONOPS to the staff but also provides additional guidance throughout subsequent steps.

Table 1. Major Steps of the CF Operations Planning Process
OPP Steps
1. Receipt of Tasks
2. Orientation
3. Development of Courses of Action (COA)
4. Decision
5. Plan Development
6. Plan Review

The staff works on Development of COAs, identifying possible COAs for both enemy and friendly forces. The G2/G3 staffs analyse the COAs in the context of the operational environment to identify plausible COAs. They then analyse strengths and weakness of all options before briefing the commander.

The Decision step begins with the COS recommending a friendly COA that the staff believes is the most likely to succeed. The commander decides whether to accept this recommendation or direct the staff to revise it or, possibly, completely reevaluate potential options. Once a COA is accepted, the commander issues the final version of the statement of commander's intent.

Plan Development is initiated once the commander has selected a COA. The staff sections produce the order while the commander and key staff members wargame the COA. The order is transmitted when the commander approves it. The G3 staff also produce tools for staff use, the Decision Support Template, Attack Guidance Matrix, and Synchronization Matrix.

Wargaming done as part of Step 5 contributes to Plan Review. The commander prioritizes contingencies identified in the wargaming and the staff develops branches to the plan where changes are deemed necessary and/or sequels that can be conducted upon completion of the originally planned actions. The commander and staff also engage in ongoing evaluation of the plan.

Related planning and decision making procedures

Other planning and decision making procedures have been developed by military and business organizations (see e.g., [7]). These methods tend to be analytic and procedural in nature, like the OPP [8]. Most take advantage of concepts of rational analysis pioneered by Herb Simon and Allen Newell (e.g., [9] [10]), in which problem solving is approached in a linear, step-by-step approach [11]. Rational analysis proceeds by 1) defining the objective, 2) performing a "search-analysis" or identifying the problem space and the current state, 3) creating and testing possible solutions, 4) deciding on a solution, and 5) implementing that choice.

It is important to note that planning procedures are not the same thing as theories of decision making. Planning procedures are doctrine that lay out procedures for conducting planning by teams of individuals, whereas decision making theories are proposed accounts of human cognitive activity. Nevertheless, planning procedures do mirror analytic theories of decision making in many respects and make explicit reference to those theories. Thus, when it is said that the OPP employs analytic processes, it is meant that the OPP has adopted the formal concepts and procedures associated with an analytic theory in an attempt to guide how planners perform their tasks.

The most prominent analytic planning model for the purposes of this report is the U.S. Army Military Decision Making Process (MDMP) [12]. The MDMP is the doctrinal planning procedure for all levels of the U.S. Army. It is very similar to the OPP, incorporating the same basic steps but differing somewhat in how they are organized. The MDMP follows seven steps, which are listed in Table 2. Each of these steps is broken into a number of sub-steps (see [13] for a detailed summary).

Table 2. *Major Steps of the U.S. Army Military Decision Making Process (MDMP)*

MDMP Step
1. Receipt of Mission
2. Mission Analysis
3. Development of COAs
4. Analyze COAs
5. COA Comparison
6. Decision and Approval of a COA
7. Production of Orders

The MDMP is relevant to the discussion of the OPP due to its similarity and because the MDMP has been extensively studied and evaluated (e.g., [7]). Deficiencies detected in the MDMP likely exist in the OPP and solutions to structural problems in the MDMP likely will be useful to the OPP. Fallesen [7], for example, has found that U.S. Army planning teams failed to follow the MDMP, despite clear knowledge of it, due to the procedure's complexity and severe time restrictions imposed by operations.

Issues pertaining to analytic planning procedures

Although the analytic approach to problem solving has been widely adopted, there are several issues that have been raised that suggest the approach is not ideally suited to military planning. In particular, the time-constrained, uncertain nature of warfare makes it a domain in which analytic processes may be difficult to perform.

Procedural constraints

Whitehurst [14] argues that the MDMP attempts to place warfare in a linear model to which it is actually ill-suited. A linear approach seeks to reduce uncertainty by decomposing a system into constituent components that can be more easily understood. Such an approach is integral to fields such as engineering but poses a problem for military operations. Linearity assumes a closed, readily decomposable system. Warfare, however, is not closed – many factors affect a battle from outside any arbitrarily drawn boundary – and all the elements within warfare interact in complex ways that make it impossible to eliminate uncertainty. Consequently, the MDMP or OPP can give the false impression that listing and considering factors has rendered the battlefield understood and certain, while non-linear dynamics progressively reduce the accuracy of assumptions over time.

Analytic processes like the OPP have fairly severe practical boundary conditions that limit their applicability to complex, real-world domains. Klein [2], for example, argues that an analytic process can work only when there is ample time available, sufficient computational resources to perform all computations and comparisons, sufficient data, and data that is unambiguous. There may be some situations in which these conditions are met but military operations are almost always time-stressed and conducted under conditions in which data is unreliable and scarce.

The discrepancy between the necessary conditions for an analytic procedure and the conditions that predominate in warfare may explain the inefficiencies observed in the MDMP. Kievennar [13], defining efficiency as "the capacity to produce desired results within desired time and with a minimum of expenditure of energy, time, and resources," found that the MDMP generally requires more steps to produce a plan of action than is strictly needed. Most steps in the MDMP, he observed, contain numerous sub-steps or actions that do not contribute to the ultimate output of a plan. Perhaps the major inefficiency identified by Kievennar is the development of multiple COAs for comparison. Although three friendly COAs are developed in the MDMP (and examined against three enemy COAs), only one is chosen and developed into a complete plan. Because COAs are compared at a stage before each of the options is sufficiently developed, Kievennar argues that the factorial comparison is not useful in determining which COA will become the optimal solution (once developed into a plan). Thus, the effort in devising and comparing the COAs it wasted. Indeed, there is evidence that comparing multiple COAs does not lead to a better plan in the end than working with a single COA [15]. As a result it is more efficient to develop just one COA fully and evaluate it against a satisficing criterion (e.g., [16]). This is likely the reason many U.S. Army officers have been observed to abbreviate the MDMP or omit the comparison of multiple COAs [13].

Human cognitive constraints

Another problem with analytic procedures is that they reduce the role of expertise in the planning and decision making processes. In particular, Klein [2] argues that analytic procedures impose six barriers to expertise, which are listed in Table 3. All

but one of these barriers (interfaces that obscure the big picture) are, to some extent, required by key principles of analytic procedures like the OPP and MDMP. Then again, it could be argued that factorial information presentation, which reduces the clarity of interfaces, may be favoured as support for analytic procedures, which involve extensive factorial comparison.

The barriers to using expertise identified by Klein [2] are inter-related. Given a complex problem, much of what happens, and hence much of the available information, will not be relevant to decision makers at all times. Analytic procedures, however, compound this problem by addressing uncertainty primarily as an issue of information availability. Procedures for breaking down the problem into discrete factors and comparing multiple options force decision makers to gather extensive amounts of data that are not needed and process that information in ways that actually obscure important patterns and inter-relations needed by experts to assess the situation. This is especially true in the OPP and MDMP, where the commander generally possesses the most expertise but is distanced from the immediate data (as the staff performs mission analysis and COA development). If a commander takes too passive a role, his/her development of a good mental model of the problem is hindered.

Table 3: *Barriers to Expertise*

Barrier	Description
Excessive Data	Decision makers require only a fraction of the information available at any given time. Analytic procedures force decision makers to review large amounts of data that are not relevant.
Pre-Processed Data	The cognitive effort involved in creating a mental model of a problem is critical to achieving understanding. Analytic procedures tend to separate data processing from decision making activities.
Excessive Procedures	Expertise is expressed when decision makers are flexible and can adapt to the specific context. Analytic procedures impose strict, formalized procedures.
Performing Formal Analysis	Experts tend to recognize situations holistically, taking into account complex patterns of factors. Analytic procedures require that factors be made explicit and evaluated separately, making it harder to recognize patterns and interactions.
Passive Data Handling	Experts build mental models actively by asking questions and seeking information. Analytic procedures formalize the information gathering process and restrict exploration.
Interfaces that Obscure the Big Picture	Formatting data in factorial ways makes it harder to detect patterns and interactions. Analytic procedures tend to favour such interfaces because they make factorial comparison easier.

Adapted from Klein [2].

It is not surprising then that numerous studies (see [3] [13] [15]) have found that expert military teams rarely exhibit behaviour consistent with the analytic planning processes in which they have been trained. Analytic procedures actually impose burdensome restraints on human reasoning and creativity.

Intuitive planning

A major distinction in the study of decision making is that of analytic or rational analysis theories on one side versus NDM or "intuitive" theories on the other [8]. This distinction is relevant here because the OPP is an analytic process that derives from the principles of analytic theories of decision making. Thus, it is worthwhile briefly contrasting analytic theories with NDM theories, which may offer an alternative approach to planning.

Analytic versus intuitive decision making

Analytic theories have a long tradition. They arise from the view of human cognition that describes humans as information processors and active planners [17, pp. 119-135]. The emphasis in explaining human decision making and problem solving is on identifying how people take in information, code it symbolically, manipulate symbolic representations, and generate some output. Analytic procedures have been successfully applied to complex, albeit highly structured, problems.

Thus, a core principle of analytic theories is that the goal of decision making is to reach an optimal decision. Optimality is a difficult concept to operationalize but it is generally defined in terms of maximizing benefits such as enemy units destroyed and friendly units preserved in tactical situations. A second principle is that decision making involves an analysis of all available data and the evaluation of all possible hypothesis [18]. Generally, analytic decision making involves the following basic steps of specifying the problem, analyzing factors, comparing multiple options, and choosing the best along certain criteria, just as in the OPP and MDMP [18].

Key to this approach is the notion of a formal comparison [2]. Analytic theories rely on a deliberate and procedural analysis to quantify alternative COAs. This assumes that all pertinent factors can be a) identified, and b) quantified in terms of their absolute or relative impact. There are numerous specific procedures for comparing alternatives, generally based on normative statistical or logical theories [19] [20].

More recently, interest has increased in so-called intuitive, or NDM, theories of decision making. It is important to note that both intuitive and analytic theories ultimately have computational bases. It is necessary to ground any theory of cognitive activity in some procedural representation. Intuitive and analytic theories differ in the kinds of procedures proposed to explain decision making. Although differences are not always completely clear-cut, analytic theories take normative models and operationalize them, resulting in detailed, factorial processes. Intuitive theories are often based not on normative analyses but strategies that experienced decision makers, or so-called experts, actually use. Intuitive theories generally entail memory-based and heuristic processes as the bases of decision making. They also focus on the use of a mental model to mentally simulate potential outcomes and eschew factorial comparison of decision options. A key reason for proposing intuitive theories was the failure of classical models to apply well in natural settings [3] [21].

Three basic principles underlie intuitive theories. The first is that decision makers generate potential solutions or COAs primarily on the basis of experience by retrieving options from memory. The decision maker identifies potential COAs by first assessing the situation then recognizing past situations that are similar. From this experience, the decision maker can recall COAs taken in the past. The decision maker must also use memory of the outcomes of the previous experiences to determine the acceptability of potential COAs.

The second principle is that decisions are made by holistic evaluation of potential COAs rather than by feature-by-feature comparison of alternatives. Rather than compare multiple options to one another, the decision maker decision maker evaluates a single option against a criterion of acceptability. Unlike analytic approaches, decision makers do not perform any factorial analyses.

The third principle is that decision makers adopt a satisficing criterion rather than search for an optimal solution. Real world situations often demand very rapid responses and decision makers may have to accept a solution that merely works and not consider whether a better solution exists. In this way, the decision maker judges the consequences and value of the COA and considers a subsequent option only if the current one fails to meet the decision maker's criterion.

Recognition-primed decision making

Research on intuitive decision making began with observations of experts in skilled domains, such as fire-fighting and military command and control, as a means to determine how experts actually solve complex problems (e.g., [3]). These studies led to observations of different kinds of decision processes employed by experts, which in turn led to a number of models to describe these naturalistic decision strategies. One of the most influential models in recent years has been Klein's [2] Recognition-Primed Decision (RPD) model (see also, [22] [23]). Like all intuitive models, it eschews formal, logical processes and instead emphasizes recognitional and pattern matching processes. The major principle of RPD is that the decision maker attempts to recognize the current situation and match it to a COA or solution that has previously been encountered.

Klein [2] presents an updated version of RPD that incorporates additional processes meant to complement recognition. According to the complex RPD model, decision makers first appraise the situation in order to classify it as familiar or not, based on experience. The familiarity of the situation can be assessed by recognizing features of the situation, recognizing a whole pattern of features that fits a familiar story or scenario, or explicitly recalling an analogy from a previous problem. From this point, there are three variants of the RPD model [2], as illustrated in Figure 1. The simplest case exists when the decision maker recognizes a match between the current problem and previously experienced situations. In this case, the decision maker retrieves a COA based on that match and implements it.

If the decision maker is unable to recognize the current situation, however, the typical reaction is to attempt to diagnose the situation and seek more information. This sort of on-going situation assessment is a crucial component of decision making in RPD [22]. There are several ways in which ambiguities in the initial situation assessment can be resolved. For

example, decision makers can use feature matching processes to more systematically review the situation and locate points of correspondence to past experience. Decision makers can also engage in active diagnostic processes such as *story building*. In this case, the decision maker deliberately notes features of the situation and attempts to create a detailed hypothesis or story that could explain that configuration of features. If there is more than one story compatible with the data, the decision maker can again gather more information and attempt to evaluate each story. Diagnosing is done until the situation can be recognized and an associated COA retrieved.

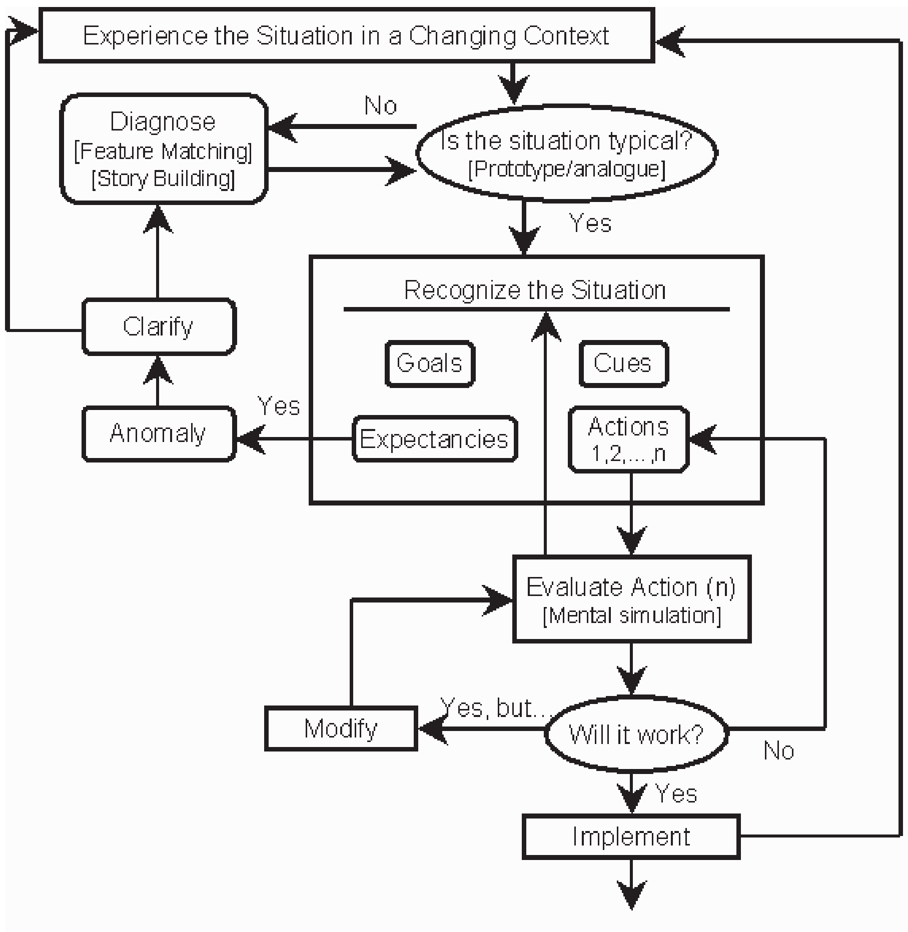


Figure 1. *Klein's Recognition-Primed Decision (RPD) Model*

When a COA is retrieved there may be doubts concerning its applicability to the current situation. In this case, the decision maker can use mental simulation of expected outcomes to evaluate the COA. This involves mentally running through the COA, critically examining how it might play out. This provides a means for the decision maker to monitor the situation and gauge the accuracy of memory before taking any action. If there are too many inconsistencies between the hypothesis and the situation, the decision maker must revise his or her hypothesis.

As the decision maker proceeds with mental simulation, he or she can also revise or reject a retrieved COA. RPD assumes a satisficing criterion. Thus, the decision maker does not attempt to generate multiple COAs simultaneously but instead generates one COA at a time, rejecting, generating, and evaluating COAs in a serial fashion [19] [24]. Also, the decision maker does not use an analytic, feature-based method to quantify the value of the COA. Rather, the decision maker can make a holistic evaluation or rely on mental simulation of the consequences of the COA. Evaluation stops when the decision maker develops an acceptable COA.

Empirical evidence supports the NDM approach for decision making in the military domain. Serfaty et al. [25], for example, observed that naval officers performed simulated anti-submarine warfare scenarios by a three-stage process of matching the situation to a schematic memory representation, gathering information to elaborate the remembered case, and then recognizing an appropriate plan for action. Other studies (e.g., [24] [26] [27]) have demonstrated that decision makers focus on recognizing the situation in making naval command decisions. Although many studies have been done in the context of naval C2, both Leedom et al. [23] and Serfaty et al. [25] have also reported findings that support the use of recognition-based decision making by Army commanders in performing simulated missions.

Studies examining the impact of constraints on decision making have suggested people act in accord with NDM because the demands of most real-life problems exceed their memory and attentional capabilities. Hutchins [18], for example, reported that operators in representative naval threat detection scenarios had difficulty maintaining situation awareness and had little cognitive capability to accomplish other tasks. Other factors that affect how a decision can be made include the decision maker’s workload, his/her familiarity with the situation, and his/her level of experience [19] [28] [29] [30]. The greater the workload, the less effort the decision maker is able to devote to conscious, deliberative reasoning processes, which make automatic processes, such as recognition and other memory-based strategies, very useful. The familiarity of the situation, however, will determine the success of these strategies. The experience of the decision maker, of course, will determine the store of memories and schemata that can be used to categorize the current situation and retrieve a workable COA.

Intuitive theories have an advantage over analytic theories in explaining decision making in demanding situations because they involve less computation and make use of more automatic processes (i.e., recognition, cue association, etc.). Thus, it is not surprising that tactical decision makers seem to exhibit behaviour consistent with intuitive theories. Some studies, however, suggest that these findings are partially due to where researchers have been looking in the decision making process as much as human decision making strategies. Roth [31] performed a study of decision making by nuclear power station crews, who may be called upon to make decisions under uncertainty and severe time constraints. Roth [31] analyzed performance of crews in simulated emergencies and observed two kinds of activity. The first consisted of monitoring and developing SA in an attempt to recognize the situation. This is consistent with intuitive decision making. In addition, Roth [31] observed procedural activity in which crews attempted to apply pre-planned responses. Thus, crews spent time before confronting the emergency in developing procedures to deal with emergency situations. Intuitive decisions seem to have depended on analytic planning done earlier.

Webb and McLean [32] documented mission planning and preparation aboard the Canadian Navy's Halifax Class Frigate, listing the critical steps taken to clarify missions and ensure the readiness of all personnel. Operations Room teams aboard the frigate spend a great deal of time planning missions and anticipating potential situations that might arise. Mission planning and preparation were a distinct phase of operations, defined by the need to acquire information about expected threats. Much of this activity focused on establishing plans to be communicated to subordinates. The plans prepared the ship and crew to meet anticipated threats by providing detailed analysis of enemy and friendly force capabilities, the political and civil situations, neutral forces, and parameters of the mission (ROE, political resolve, etc.).

Planning is, in general, critical to support decision making during operations. In a study of AEGIS class cruiser commanders, Kaempf et al. [27] found that 95% of situation assessment decisions were made by a recognition-based process. Only 5% of decisions indicated an analytic strategy. In addition, the most frequent diagnostic strategy was feature matching (88%), in which commanders made use of just a few clear features (e.g., bearing, response to warnings, etc.) to recognize the kind of target indicated. Commanders did use mental simulation in 11% of decisions, particularly the most difficult.

Relevance of intuitive decision making to planning

It is worth considering theories of intuitive decision making in the context of operational planning for two reasons. First, the planning process is intended to serve as a bridge between preparation for an operation and actual decision making in the field [1]. Thus, there should be a meaningful link between how the commander and staff plan the operation, and the products they produce, with the ways people naturally think and decide while conducting the operation. What are the characteristics of intuitive decision making and what demands do they place on a planning process designed to suitably support that decision making?

A second reason to explore intuitive decision making theories is that the broad concepts of decision making, problem solving, and planning are not strictly exclusive of one another. In the context of military operations, it is rare that researchers adopt the technical definition of decision making as only the selection of an option from a set of alternatives and, instead, use the term to generally refer to any activity in which a goal state is pursued [33]. Planning, like problem solving, entails the definition of the problem, the construction of alternative COAs, and the selection of one alternative. Thus, the overlap among decision making, problem solving, and planning renders a strict distinction among them of little use. Theories of intuitive decision making can inform how people solve complex problems or plan operations in natural settings. What aspects of intuitive decision making can provide superior concepts for the planning process?

Intuitive planning

Recognizing the relation of decision making and planning, some researchers have begun to explore what can be termed "intuitive planning" processes. By intuitive planning it is meant a process aimed at developing a plan of action that eschews traditional analytic procedures in favour of less formal, NDM-inspired procedures.

Observations of planning

Studies examining military planning have found that expert teams not only deviate from the prescriptions of the analytic planning process but also spontaneously shift into processes consistent with intuitive decision making (e.g., [7] [27]). Athens [34], for example, examined two historical case studies of operational planning in detail to determine how planning in these cases compared to the doctrinal procedure. The two cases were Field Marshall Slim, commander of the British forces in Burma during World War II, and Major General Adan of the Israeli Defence Force in the 1973 Arab-Israel war. In both these cases, the commanders strongly emphasized situation awareness in their planning and decision making activities. They also eschewed factorial comparison of multiple options, favouring instead to sequentially create and evaluate COAs and revise these as needed. Also in both cases, commanders and their staffs engaged in "progressive deepening," a process of mental simulation in which a potential COA is elaborated and critically evaluated as part of its development.

Others have attempted to characterize how expert teams approach problems and the strategies they use in planning their responses. Pounds and Fallesen [35] reviewed the scientific literature and found over sixty unique strategies that can be applied in complex problem solving. They note that the usefulness of any given strategy depends on the nature of the problem and the level of experience of the decision makers. Pounds and Fallesen [36] interviewed 82 military commanders about their problem solving approaches and specific strategies in the context of three tactical situations. They found that about a third of the persons interviewed held general planning themes that guided all of their activity in dealing with the tactical problems. The participants also revealed a large number of specific strategies that could be called upon as needed, although the participants did not show an overwhelming degree of agreement as to which strategy was appropriate at any given moment in a scenario.

Bruyn, Rehak, Vokac, and Lamoureux [37] observed a Canadian Mechanized Brigade Group (CMBG) Staff during an exercise and all functions performed by the planning Staff during several planning cycles. The functions observed were compared to a previous function flow analysis of the OPP prescribed by CF doctrine (see [5]). Bryun et al. [37] reported two major findings concerning the application of the OPP by an actual planning staff. First, not all the functions of the OPP as described in doctrine were performed. In particular, numerous sub-steps under the major functions were omitted or abbreviated. Second, the planning staff engaged in a great deal of 'looping' back and forth between functions. This was true mainly of lower level functions. The abbreviation and repetition of lower level functions, seemingly in groupings, suggests that these functions are strongly linked and performed as more of a continual process than discrete steps. As well, it was observed that the planning process was indeed "command-driven" as the Commander was involved in the majority of the critical decisions made by the planning Staff.

It was also observed that there exist several constraints that may affect the way in which the OPP is applied including time, mission type, the transference of a plan from Plans to Operations. With respect to time, it was concluded that the OPP at Brigade-

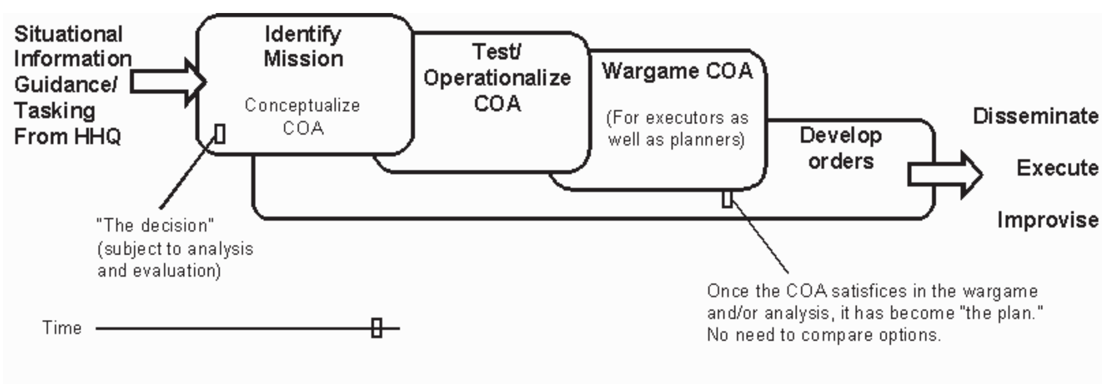
level, with the possible exception of initial planning, will almost always be time constrained. As such, the process will be abbreviated and requires specific planning direction from the commander.

Overall, it was concluded that the CMBG planning Staff followed a step-by-step analytical decision making approach for higher level OPP functions, but more intuitive processes to perform specific, individual functions. It appeared that the input of various staff to the OPP was intuitive, or at least based on his/her own estimate of the situation, compiled from various sources. These results suggest that, in general, application of the OPP at the Brigade level may be a hybrid of analytic and intuitive decision making.

Klein's intuitive planning model

An attempt to translate concepts of intuitive decision making into a prescriptive planning process has already been undertaken by Klein and colleagues [38]. The RPD model sets several basic requirements for successful decision making [2]. These are a) a clear definition of the problem and one's goals or desired end state, b) good awareness of the situation to allow for recognition, and c) expertise of the decision makers so that they can interpret data. The Recognition Planning Model (RPM) derives from the RPD model of decision making [15] and ensures that these requirements are met so that, once an operation is underway, the plan will aid decision makers to adjust to changing circumstances.

The RPM process follows four stages, although the term "stages" is not optimal because activities are intended to be iterative and performed as needed throughout an operation (see [15]). The stages are illustrated in Figure 2, which shows them as embedded within one another to capture their iterative nature.



HHQ = Higher Headquarters

Figure 2. *Klein's Recognition Planning Model*

The first stage comprises mission analysis. The aim of this stage is to build understanding of the mission to be accomplished. When a mission is received from higher headquarters, the commander and staff attempt to understand the nature of the mission and its requirements. Depending on the familiarity of the mission, the

commander and staff may engage in extensive analysis through information gathering, feature matching, and story-building [4]. The commander takes the lead in mission analysis and conceptualizing the COA to ensure that the person with the greatest expertise directs these activities. A key aspect of the first stage in RPM compared to analytic processes is that the commander and staff work to conceptualize a COA *while* analyzing the mission. This is important because identifying a base COA early on will guide mission analysis and focus thinking [15]. Identifying a base COA early in the process does not commit the commander to retain this COA. The initial COA is used to aid understanding and is evaluated when the commander is confident that enough is known about the mission to proceed. The COA can be revised at any time or discarded and a new COA developed.

In the second stage, the staff operationalizes and tests the COA by comparing it to a satisficing criterion. The criterion must be based on the analysis of the mission objectives to provide clearly defined conditions that must be satisfied for the mission to be successfully completed. Consistent with intuitive decision theories, the evaluation is holistic and performed on just the one COA initially developed. The evaluation can be conducted by mental simulation of the expected outcomes. As the COA is evaluated, greater detail can be specified and the staff may begin preparing operations orders. If any flaws are discovered that render the COA unworkable or insufficient to achieve all mission objectives, a new COA is devised and tested.

The third stage is to wargame the evaluated and accepted COA. Unlike the OPP or MDMP processes, the RPM does not used wargaming as an evaluation procedure but, instead, as primarily a rehearsal and opportunity to work out necessary products such as the execution matrix. A COA can still be rejected at this stage if the commander or staff determine some aspect is not suitable but the main intent of this stage is to work the COA from a concept into an executable plan of action.

The fourth stage is to develop the orders based on the wargamed COA. This is the most procedural step as the creative work has already been done. Work begun in early stages to lay out and test the COA can now be used as the bases of orders. Unlike the OPP and MDMP, in which multiple COAs are compared, the RPM does not require the staff to wait until after the comparison to begin to draft orders, as only a single COA is considered at a time [15].

The rationale underlying the RPM and analytic models (OPP and MDMP) are quite different. Most notably, the RPM process does not include any factorial or multi-attribute analyses and the criterion for accepting a COA is one of satisficing rather than optimization [15]. Research has not yielded much support for the assumption that comparison of multiple options results in better outcomes [39]. The RPM process is predicated on the assumption that more detailed consideration of a single COA, with a willingness to revise or reject it at any point in the process, produces a better plan in the end than attempts to work on several COAs simultaneously. As discussed previously, staffs rarely fully perform the MDMP in the field due to time pressure [2]. In contrast, the RPM, which eliminates some stages (COA comparison and COA approval) and streamlines others by focusing on one COA, reflects a natural strategy that may be more resistant to time pressure [15].

Whereas analytic planning processes operate on the principle of factorial comparison, RPM works on the principle of mental simulation. This describes the creative aspect of planning and provides a general framework for identifying an initial COA and working it into a form that can be evaluated. Klein and Crandall [40] model the process of "progressive deepening," which is a process of elaboration by mental simulation, as illustrated in Figure 3. This model helps to formalize the ideas of understanding the mission and testing the COA.

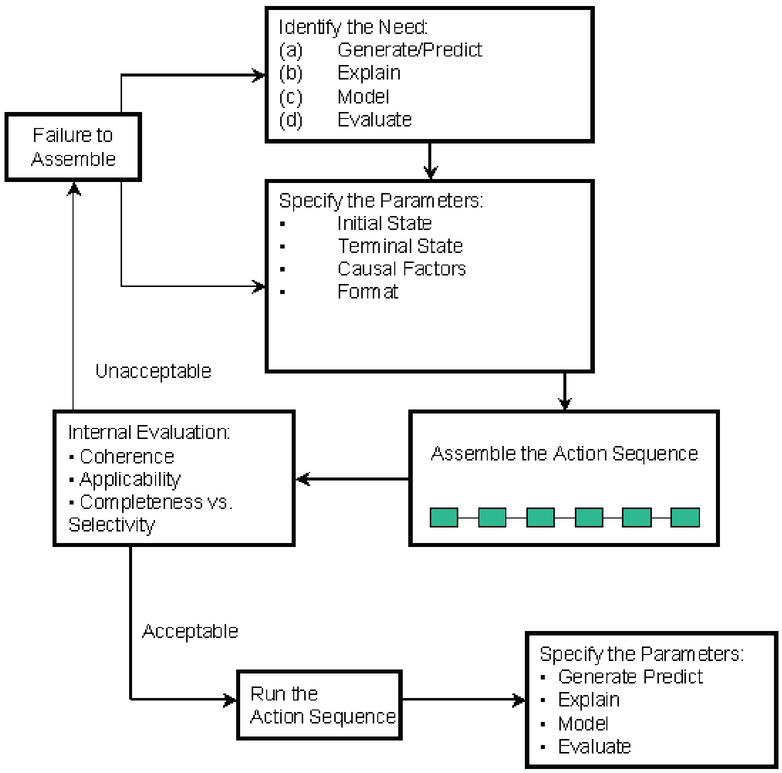


Figure 3. *Klein and Crandall's Model of Mental Simulation*

An important aspect of this model is the idea that the COA should be explicitly represented in terms of a sequence of states. Thus, the main parameters identified are the initial and terminal (desired) states, the causal factors that can translate from one state to another, and the format (actions) that those causal factors can take. The COA is represented as a sequence of states and the actions needed to move from one to the next. This sequence is what can be mentally evaluated in two parts. First, the COA is evaluated for its internal consistency, coherence, applicability, and completeness. Then, the COA can be evaluated in terms of the likelihood that it will achieve the objectives of the mission.

Kievennar's abbreviated planning process

Other researchers have developed alternative planning processes that incorporate various concepts of intuitive decision making. Many of these processes are general

problem solving procedures that could be useful in considering military planning but which do not specifically address key C2 issues (e.g., [41]). Others, however, have directly addressed military planning. Kievennar, for example, has addressed the possibility of revising the U.S. Army's MDMP by incorporating intuitive concepts.

Having judged the MDMP to be inefficient in the military domain, Kievennar [13] recommended several changes to the MDMP:

- Clearly state the commander's involvement in the planning process;
- Adopt a purpose and end state for each step in the process;
- Adopt a more directive COA Development process that is focused on actions at the decisive point in the mission;
- Clearly specify when warning orders should be issued and what they should contain; and
- Wargame only for the purpose of synchronization.

With these recommendations in mind, Kievennar proposed an accelerated decision making and planning model, which is illustrated in Figure 4. The process is commander-driven, with staff assisting. The commander is responsible for providing one COA to the staff to be fully developed. Because the commander is directly involved in the creative work of each step, there is no need for three different briefings as called for in the MDMP.

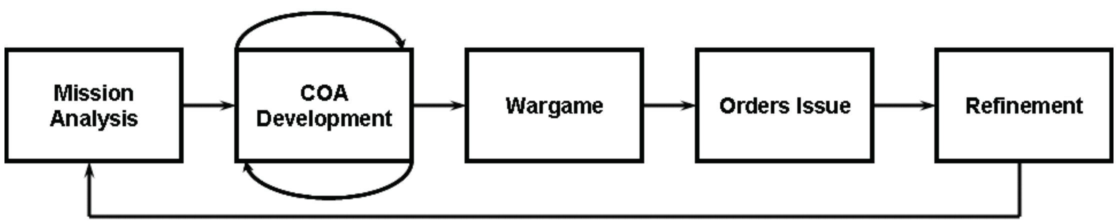


Figure 4. *Kievennar's Abbreviated Planning Process*

The first step, mission analysis, is aimed at understanding how the enemy will fight and creating a framework in which to plan for the fight. The desired endstate of this step is the shared visualization among the commander and staff members of the battlespace and the commander's intent. In the next step, COA Development, the commander and staff develop an initial concept of how to accomplish the mission objectives and refine that concept. This is a highly iterative process. The endstate is a plan that is focused on achieving the mission objectives. The third step is Wargaming but, unlike the MDMP, this step is not intended to serve as an evaluation of the COA. Evaluation is done in the iterations of COA Development. Instead, Wargaming is done to synchronize the plan in time and space and, hence, make it practically workable. The endstate to this step is a synchronized plan, expressed in appropriate products, such as the Decision Support Template (DST) and initial

Decision Support Matrix (DSM). The fourth step, Orders Issue, is largely procedural with the aim to convey the plan to subordinates, using verbal, textual, and graphical means as appropriate. The endstate of this step should be a shared understanding among the commander, staff, and subordinate leaders of the purpose and plan of action for the mission. The final stage is Refinement. As subsequent information becomes available, however, the commander and staff must reiterate the COA Development step and further develop branches and sequels. The endstate of the step (although it is somewhat awkward to call it that given that COA Development is an ongoing stage) is a flexible plan, focused on achieving mission objectives, with developing contingencies.

Whitehurst's abbreviated military planning process

Whitehurst [14] rejects the linear approach underlying the MDMP, arguing that warfare is not a simple closed system that can be fully broken down and understood as a set of component parts. Instead, he argues that non-linear dynamics will make warfare inherently uncertain and the sort of factorial analysis of the MDMP unworkable. As an alternate approach, Whitehurst advocates three general concepts aimed at reducing uncertainty in non-linear systems: Anticipation, Flexibility, and Focus.

Anticipation involves understanding what questions one needs to ask in order to seek information that will be relevant and timely. Relevant information is that which either shapes or predicts future enemy actions. Thus, rather than attempting to fully analyse all possible enemy COAs, one seeks to learn the specific COA the enemy will employ. To be successful, the commander must be able to adapt (i.e. be flexible) as the situation, including enemy COA, becomes more clearly resolved. Developing branches and sequels (i.e. contingencies) is a technique for adapting when assumptions are proved incorrect. To be focused, a planning process must avoid multiple COAs in favor of a visualization of the dynamics between friend and enemy forces. That is, a single COA is pursued in such a way as to anticipate when it will likely be necessary to initiate a contingency. Thus, the focus of planning remains on a single option but takes into account multiple points at which the plan might be adapted.

Whitehurst [14] points to critical thinking as a means to put these concepts into practice. Critical thinking involves questioning one's mental model to find hidden assumptions and evaluate whether these assumptions are plausible. According to Whitehurst, the complexity of military operations requires a reductionist, analytic approach like that of the MDMP to maintain an organized, focused effort in planning. Critical thinking, however, guards against the weaknesses of analytic thinking by pointing out gaps and conflicts in reasoning and the acceptance of unreasonable assumptions. Thus, critically evaluating one's analysis of the mission precludes generation of multiple COAs as competitors but facilitates the development of contingencies to the one COA that is developed.

Whitehurst [14] offers a simplified planning process based on these concepts, which is illustrated in Figure 5. The process contains two major changes to the MDMP.

First, there is a new step of developing the complete Enemy COA (ECOA) (with assumptions, branches, and sequels), which follows Mission Analysis. The purpose of completing the enemy COA is to provide a detailed model of the enemy for use in developing the complete friend COA. The second major change is a new step of Contingency Planning, which replaces COA Analysis, COA Comparison, and COA Approval in the MDMP. This step explicitly questions the assumptions, conflicts, and gaps in the mental models created in the ECOA and COA Development stages, which leads to discovery of weakness that can be dealt with through contingencies. This simplified planning process combines analytic procedures of the MDMP with critical thinking and intuitive reasoning.

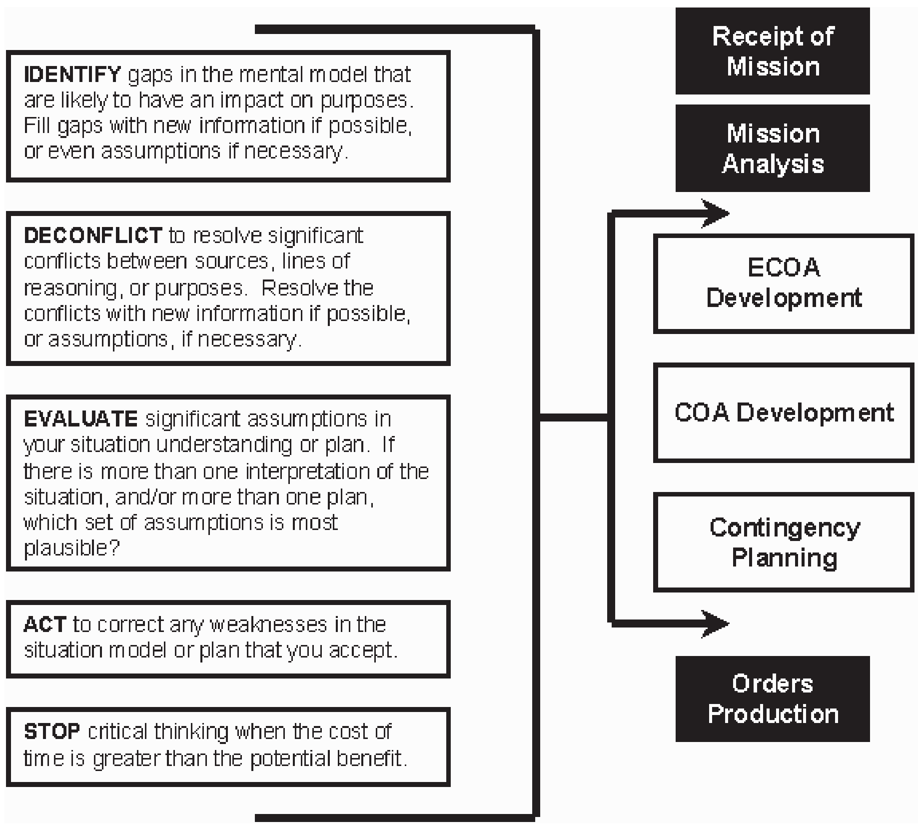


Figure 5. *Whitehurst's Abbreviated Military Planning Process*

Figure 5 also illustrates a change to the way COA development is performed in Whitehurst's process. Rather than follow the factorial procedure of the MDMP, Whitehurst suggests that COAs be developed through an intuitive process described by the acronym IDEAS, standing for Identify, Deconflict, Evaluate, Act, and Stop. The definitions of each of these steps is indicated in Figure 5. Essentially, IDEAS comprises an iterative means to refine the commander's mental model of the enemy and friend COAs. The so-called Crystal Ball Process is a technique that can be used to critically evaluate COAs and uncover assumptions. In this technique, one imagines that the COA has failed and attempts to identify potential reasons for its failure. This forces planners to consider reasons why a COA may not be plausible.

The ECOA Development and COA Development steps are illustrated more specifically in Figures 6 and 7. Whitehurst rejects development of multiple ECOAs because this prevents detailed examination of the assumptions and rationale underlying the enemy's tactical and strategic perspectives. Thus, the process does not examine all possible options for the enemy but creates a more detailed and critically evaluated model of what the enemy's COA likely will be. The outputs of ECOA Development become inputs to COA Development. Again, only a single COA is pursued, one that directly affects the critical vulnerabilities of the enemy and exploits potential opportunities. The outputs of COA Development are a fully developed and evaluated COA, an initial Decision Support Template (DST), an initial Decision Support Matrix (DSM), recommended Friendly Force Information Requirements (FFIR), and a list of friendly assumptions.

To deal with uncertainty, the next step of Contingency Planning considers potential deviations from the expected ECOA and COA. This step produces the branches and sequels that go into the final plan.

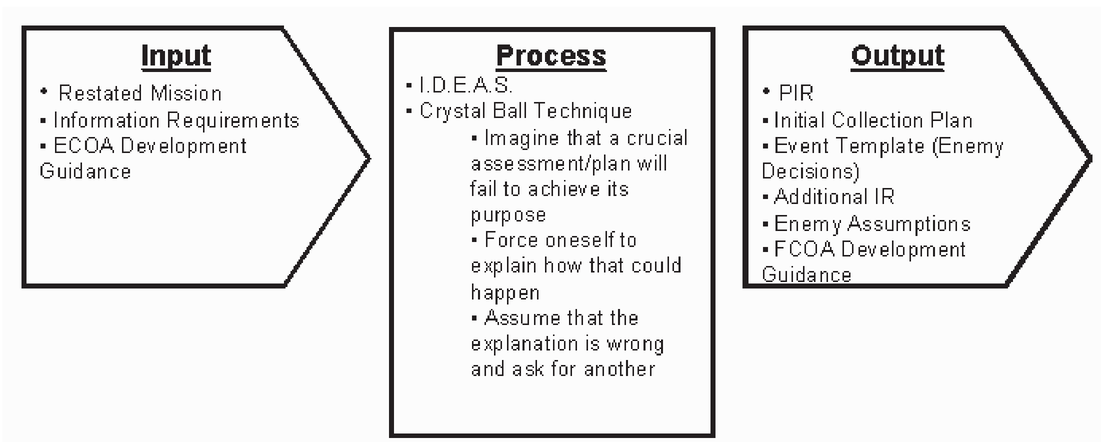


Figure 6. *Enemy COA (ECOA)*

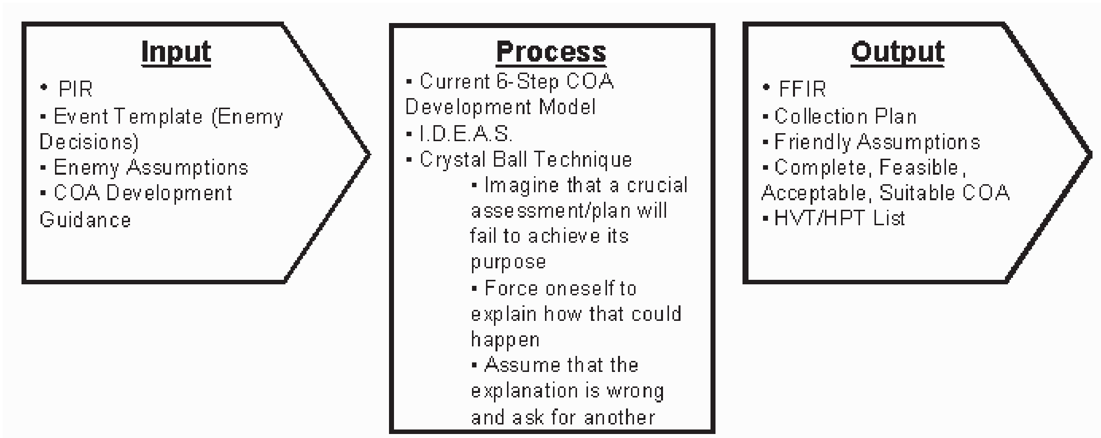


Figure 7. *COA Development*

Concepts for intuitive and abbreviated planning procedures

This section reviews concepts and procedures to support more efficient intuitive planning.

Supporting natural decision processes

Planning is intrinsically linked to decision making in the field. For this reason, it may be counter-productive to employ separate and different processes in planning and decision making [11]. In particular, COAs and contingencies derived through an analytic process such as the OPP may not be entirely consistent with the kinds of decision making processes commanders are likely to employ as the operation unfolds [8]. When time is very limited and information not readily available, as is most often true during operations, commanders generally rely on their intuitive capability to rapidly assess the situation and immediately understand what to do. Thus, the planning procedure should be aimed, at least in part, at supporting this sort of decision making.

What, then, is required of a planning process to adequately support decision making in the field? The prerequisites for intuitive decision making are [34]:

- Experience and well-organized knowledge bases;
- Timely and accurate situational data;
- Focus on a single COA or option at a time;
- Progressive deepening, or mental simulation, to evaluate the COA and project possible outcomes; and
- Clear criteria for assessing whether the COA is satisfactory.

In other words, a planning process should support these characteristics. Subsequent sections will explore planning concepts and procedures to do this in more detail. It is possible, however, to immediately see some ways in which the planning process could be structured to support the prerequisites listed above. To aid later recognition and pattern matching in intuitive decision making, a planning process should impose structure on the operation, thus providing a framework in which to classify events and situations. Emphasizing simplicity, through the pursuit of a single COA and simplified procedures for evaluating that COA, sharpens the focus throughout the operation on achieving mission objectives [11]. Similarly, defining mission objectives explicitly in terms of desired endstates make evaluation criteria easier to understand and apply in judging whether actions will move the force toward those desired endstates.

General lessons from previous research

The importance of experience

Experience plays a key role in intuitive decision making models such as RPD. Experience is the basis of recognition of problems and matching of appropriate actions. Expertise also serves in estimating probabilities and mental simulation to project likely events [16]. This has obvious training implications, notably that military commanders need to both train to gain practical experience as well as train to use that experience effectively [42]. The value of an extensive knowledge base is dramatically enhanced through strategies to access that knowledge in operational contexts.

The importance of expertise to intuitive decision making also has implications for the way military units plan. Planning can be viewed as a form of metacognition; i.e. a means of controlling the decision making process in an intelligent manner. A planning process should organize the model of the battlespace and COA in ways that make critical situations readily recognizable and retrievable in the heat of action. A planning process can also be designed to take advantage of decision makers' tendency to use RPD in time-stress situations. By planning contingencies, one can link branches and sequels to highly recognizable conditions that serve as triggers.

The importance of critical thinking

Among the important functions of mental simulation is the discovery of problems in one's plan [40]. As part of COA evaluation, planners must explore possible outcomes of the plan to determine how a plan might fail, the consequences of its failure, and options that exist to enhance the plan. This is the fundamental rationale for contingency planning where branches and sequels in a COA are developed [14].

Cohen, Freeman, and Thompson [43] have proposed a four-step process, termed STEP (for Story, Testing, Evaluation, and Plan), to assess the COAs that are retrieved through recognition-primed processes. In the *Story* phase, the decision maker attempts to construct an explanation or story that explains the current situation and predicts future events. In the *Test* phase, the decision maker compares these predictions to observations. This phase serves the additional purpose of guiding situation assessment so the decision maker can focus on the most relevant data. The *Evaluation* phase leads to a decision as to whether the Story is plausible. If not, the cycle begins again. Once a story is accepted, the decision maker enters the *Plan* phase and develops a COA.

The STEP procedure has been developed into a training course for enhancing critical thinking skills [44]. The goal of STEP training is to help trainees build situation models or templates that will form the basis of expertise. Training is highly context dependent and practically oriented. Trainees learn by solving scenarios and analyzing the nature of scenarios. Cohen et al. [43] identify a number of benefits of this approach, notably that it facilitates development of a "big picture." Overall, the STEP

training regimen teaches trainees how to solve tactical problems by doing what current experts do, while learning in realistic contexts. Freeman and Cohen [44] empirically validated the STEP approach and found that, compared to conventional training methods, personnel trained by STEP identified more conflicting evidence in scenarios, generated more explanations, gave more arguments supporting assessments, and produced more alternative assessments. Overall, STEP trainees made better situation assessments and developed better tactical solutions.

A similar training technique, developed by Pliske, McCloskey, and Klein [45], makes use of tactical simulations that present the trainee with a problem requiring assessment and decision. The goal again is to help trainees learn the kinds of situations they will face in the field and the kinds of solutions that can be applied. To help trainees clearly identify the critical cues and understand good solutions, trainees engage in a number of critiquing exercises. These exercises include identifying decision requirements, summarizing commander's intent, and the "PreMortem" exercise of identifying key vulnerabilities in a plan. The PreMortem is a potentially very useful exercise in which a group imagines that a proposed plan has failed and spends some time identifying reasons why this could have happened. This exercise helps trainees uncover flaws in plans and learn self-criticism. Fallesen and Pounds [46] similarly advocate the strategy of "relevancy checks," in which planners discuss possible outcomes, posing various "what-if" and "what-else" questions to help teams to critically evaluate their plans.

The importance of shared visualization

The OPP and similar processes specify in great detail the information necessary to plan effectively. Goal setting, information gathering, and identification of assumptions and factors are key steps in all planning and problem solving techniques [41]. In military planning, the results of these steps must necessarily be shared among a large number of individuals both within the planning staff and among distributed units of the friendly force. Unfortunately, although this shared understanding, and the synchronization of forces that depends on it, are key military tenets, the complexity and uncertainty of the battlespace make it difficult to achieve [47]. Thus, it is imperative that some coordinated mechanism exists within the planning organization to facilitate shared understanding.

The notion of shared understanding is at the heart of Klein's [2] Advanced Team Decision-Making (ATDM) Model. He proposes that "team cognition" is a core competency of a team, which allows the team to work as an intelligent unit that thinks and acts collectively. This is indicated by four concrete behaviors at the team level:

- Clear envisioning and description of goals and plans;
- Directing attention to events at the proper points in the time line;
- Managing uncertainty by discovering and filling gaps in the team's knowledge base and reconciling inconsistencies and contradictions; and

- Actively seeking views of all team members and working toward a common assessment of the situation.

  Team cognition in Klein's ATDM model is coordinated by team metacognition, the regulatory processes that govern how team members interact and agree. Team metacognition consists of self-monitoring, time management, and leadership processes, which contribute to the overall team's ability to observe itself, identify weaknesses in its procedures and cognition, and devise and implement corrective actions.

  Military planners, however, can often have difficulties with metacognitive processes for managing the planning process and communicating among staff. Fallesen [48] suggests that training in alternate ways of reasoning could enhance planning performance by encouraging greater shared understanding. In particular, Fallesen has recommended that visualization, the process of conceiving and documenting the plan, should be done proactively and include clear forecasts of the current situation and desired endstate. In part, the greater focus should be placed on identifying potential areas of confusion or ambiguity in the plan and addressing those immediately to cut off misunderstandings before they arise.

Proposed planning concepts

Based on the general lessons-learned and the preceding discussion of theories of problem solving, it is possible to draw a number of specific planning concepts for consideration (Table 4). Each of the following concepts, discussed in detail below, can serve as an hypothesis for developing a more effective and efficient planning process for the CF.

Table 4: Proposed Planning Concepts	
Planning Concept	**Rationale**
Fewer Stages	Intuitive processes do not require extensive formal procedures and steps performed in Mission Analysis, COA Development, and COA Comparison can be eliminated.
Pursue a Single COA	There is little evidence that the analytic strategy of developing and comparing multiple COAs results in better plans than iterative development of a single COA.
Less Factorial Analysis and More Holistic Evaluation	Adoption of a satisficing criterion eliminates the need for factorial analysis of options.
Commander-Driven COA Development	Experience is paramount for intuitive decision making so that the commander, who has the most experience, should direct the initial mission analysis and generation of a base COA.
Earlier Selection of a COA to Pursue	Selecting a base COA early in the process, prior to completion of Mission Analysis, does not impair subsequent analysis and provides a framework for gathering information and developing evaluation criteria.
Explicit Assumption Analysis	Assumptions in the COA must be identified and evaluated to confirm their validity.
Create a Plan of Assessment	Concurrent to development of a COA, planners should develop a plan for evaluating the effectiveness of the plan once the mission begins to facilitate revision and adaptation to unforeseen events.
Create a Common Conceptual Model (Visualization)	Plans should be represented in terms of the initial state, desired endstate, and transition states that form the basis of the action sequence; the commander, staff, and subordinates require the same understanding of this conceptual model.
Wargame for Synchronization	Wargaming is time-consuming and best used to synchronize actions within the plan rather than evaluate fundamental aspects of the COA.
Emphasize Critical Thinking and Evaluation	Critical thinking is necessary to ensure sufficient creativity and flexibility in developing a COA.
More Emphasis on Experiential Training	Experience is necessary for effective intuitive decision making and experiential training methods enhance the ability of commanders to associate conditions in the battlespace to practical knowledge.

Fewer stages

Theories of intuitive decision making argue that expert decision makers perform best when they do not attempt to engage in extensive analysis but, instead, employ recognitional strategies to assess the situation and retrieve a COA (e.g., [4]). A key implication of these theories, then, is that problem solving and planning should be based on a less formal and less extensive procedural basis. Eliminating the

breakdown of the problem into specific factors and the exhaustive review of these factors in the evaluation of potential COAs has the effect of greatly reducing the number of stages in a planning process. Recognition-based models suggest a planning process in which the initial Mission Analysis and COA Development stages of the current OPP are abbreviated by eliminating numerous specific steps within each stage. Moreover, excessive procedures are a barrier to the use of expertise as excess procedures distract from the creative aspect of developing a COA [2]. A specific recommendation for reducing the number of stages is to pursue a single COA, thereby eliminating all steps pertaining to the comparison of COAs.

Pursue a single COA

Intuitive theories also suggest that experts need only pursue a single COA rather than generate and compare multiple options. There are quite a few reasons why this should prove an effective measure. As Whitehurst [14] has pointed out, multiattribute analyses depend on a large volume of certain facts for the analysis to have any value. In domains where there is extensive uncertainty, especially in terms of ambiguity of data, factorial comparison among multiple alternatives does not yield reliable results.

From the perspective of recognition-based decision making, it is reasonable to retrieve a single COA in response to a problem and evaluate it against criteria of effectiveness rather than optimality. Generally, experts have been observed to retrieve high quality solutions to problems in their initial attempts to solve problems, suggesting that a single COA approach is likely to produce a suitable solution quickly [24] [49]. In fact, holistic evaluation is not condusive to multiple comparisons among alternatives. Because satisficing criteria refer to the expected outcomes of a potential COA, rather than specific factors, it is less cognitively demanding to mentally simulate the expected outcome of a single COA and judge its acceptability than to hold multiple mental simulations in mind at once. The satisficing criteria of holistic evaluation are suitable to the demands for speed and effectiveness imposed in military planning.

Thus, comparing multiple COAs is inefficient as it consumes cognitive resources while preventing planners from focusing on understanding the mission and the opponent [14]. Multiple COA comparison is also inefficient because it separates the development and evaluation phases. Under the OPP, at least three COAs are to be developed then compared, meaning that at least two COAs will be developed that will not play any role in the operation [13]. Nor do the discarded COAs usually provide any significant input into the selected COA (i.e. make it better). When development of a single COA is more closely integrated with its evaluation, as in an iterative process of development, evaluation, and revision, then ideas that would otherwise be diverted into separate COAs can be considered with respect to the COA developed and selected for implementation [14]. Pursuing only one COA at a time also makes it easier for the commander to direct the COA development process and lend his or her expertise to the initial concept for the COA [13].

Less factorial analysis and more holistic evaluation

As noted, a satisficing approach to COA evaluation generally yields suitable solutions to problems [4]. Optimizing strategies will generally not work under conditions of uncertainty or when time and resources are severely constrained, so that attempts to optimize in these circumstances yield only subjective judgments of what option is best. Satisficing is more efficient because it considers the expected outcomes of a COA rather than the entire range of factors that differentiate that COA from others. This reduces the analysis. Satisficing also more directly deals with potential weaknesses of a COA by focusing on outcomes [4], which aids in revision of the COA as part of iterative development.

Commander-driven COA development

Among the prerequisites for effective intuitive reasoning are experience, a well-organized knowledge base, and good metacognitive skills, which are generally characteristics best represented by the commander [34]. For this reason, the OPP, MDMP, and other formal planning processes state that the commander should drive the entire process and the development of the COA in particular. Such formal processes, however, can impose obstacles to the commander through their structure. Specifically, if multiple COAs are to be developed and compared through a factorial analysis, it becomes difficult for the commander to lead the process while honestly developing multiple COAs that are not simply "strawmen" to the commander's initial concept. If the commander suggests a COA, the staff will typically concentrate on that, undermining the purpose of multiple COAs. Perhaps as a result of this, successful commanders have focused on elaborating and revising their own single concept throughout an operation [34]. As a key aspect of planning, the commander should provide his/her staff with a single COA to develop as well as specify clear outputs expected for each stage of planning [13].

Commanders' expertise not only makes them best suited to the creative aspects of COA development but suggests that the commander will develop the best situation awareness as the operation unfolds. Experts generally develop the best SA and so the commander will have the best understanding of events and thus be better able to recognize patterns that are relevant to how the plan is put into action and when changes are needed [2].

Earlier selection of a COA to pursue

In addition to limiting COA development to just one COA, Whitehurst [14] recommends deciding on a concept to be developed earlier in the process than required by current doctrinal procedures. Although one might fear that committing too early to a COA might restrict subsequent development, Whitehurst points out that having a concept in mind actually facilitates analysis and understanding of the mission. The preliminary concept guides questioning and exploration, leading the commander and staff to identify important aspects of the mission and context. It is

important to integrate COA development and COA analysis in order to ensure that the initial COA is thoroughly evaluated and revised appropriately throughout the process.

Assumption analysis

One function of mental simulation is to help planners identify assumptions inherent to their plan [4]. This is necessary to accurately predict outcomes and evaluate the plan. Thus, several writers have advocated the inclusion of an explicit step in planning to identify assumptions in the COA. Whitehurst [14] recommends that planners list assumptions as they develop a COA and judge the reliability of these assumptions as part of the evaluation. Similarly, Fallesen and Pounds [46] have argued that military staff be trained to perform "relevancy checks" as a normal part of planning. Relevancy checks entail generating "what-if" questions to consider possible problems with a COA or potential events that would affect how that COA might work. Relevancy checks are a means to stimulate critical thinking as well as richer understanding of the mission and COA.

The value of assumption analysis is two-fold. First, explicitly identifying assumptions helps planners better understand the mission and plan itself, which contributes to better analysis and communication. Second, when assumptions are explicitly identified, planners can evaluate the truth and consistency of those assumptions. A major part of COA evaluation should include identifying gaps, inconsistencies, and contradictions among assumptions and measures to resolve these problems. In addition, assumptions are key indicators of what information needs will exist throughout an operation. Assumptions represent necessary conditions for the validity of the plan, so it is crucial to evaluate the accuracy of assumptions.

Create a plan of assessment

Although there is a tendency among military planners to separate planning from the execution of a plan [8], it is important that planning and execution be viewed as part of an integrated system [50]. Activities laid out in the OPP are just the initial stages in a process that requires constant evaluation and revision of the plan. Despite this, the OPP does not instruct planners to develop an explicit framework in which to evaluate the plan as the operation is conducted – a plan for evaluating the plan itself [41]. Thus, whereas extensive analysis may be done to evaluate the suitability of a COA, the analysis of outcomes, as it is implemented, can be somewhat ad hoc. For this reason, it makes sense to include a step in planning in which specific desired outcomes are identified and measures of those outcomes developed. The measures serve as ways to judge the extent to which desired outcomes are achieved, which then indicate whether the plan is being performed as intended. Criteria for judging the success of achieving goals also help planners anticipate failures or problems before they become critical [41]. When measures indicate low success in achieving some intermediate goal, this acts as a warning that subsequent goals may not be met.

A plan of assessment should be integrated with the plan of action and directly relate to observable consequences of actions. In other words, as the COA is developed, measures and criteria of success can be linked to the action steps in the COA.

Create a common conceptual model (visualization)

The earlier discussion of lessons-learned highlighted the importance of shared understanding, or visualization, to effective planning by teams. In light of this, it is important to seek practical means of facilitating shared understanding within planning teams. Klein's [2] ATDM model for team decision making provides a framework in which to consider issues of shared understanding. It points out the main considerations in determining how well a team will work together and how well knowledge will be shared. Specifically, Klein's ATDM points to team competencies (abilities of team members), team identity (organizational and interpersonal interaction), team cognition (knowledge and reasoning), and team metacognition (monitoring of functions) as parts of team functioning that must all work for the team to be effective. All these areas affect what knowledge the team develops and how it is shared among team members. Thus, it is possible to promote shared understanding by:

- Supporting individuals in their roles;
- Supporting effective interactions and positive feelings among individuals;
- Supporting verification and distribution of a single accepted knowledge base; and
- Supporting metacognitive processes.

Sharing the commander's intent is the bedrock of shared understanding and synchronized operations [47]. Yet the best way to formulate and distribute the commander's intent is still a topic of debate [51]. Generally, shared intent is seen to consist of more than just the formal statements of intent propagated by the commander [52]. Although, explicit intent is shared through explicit communication in some form (usually written or verbal directives), sharing implicit intent is a long-term preparatory activity that must be supported by the whole military organization. Organizations must support development of *shared* implicit intent by supplementing formal activities such as education and training in doctrine and procedures with opportunities for team building and personal interaction [51]. These activities convey implicit knowledge, expectations, and values that people internalize.

Wargame for synchronization

Wargaming is a means of evaluating a COA by simulating the expected outcomes of actions given well-defined assumptions about the enemy and battlespace. Wargaming is included as a method for comparing COAs [5] in the OPP as well as the MDMP [13]. Although simulation seems a reasonable approach to evaluation of COAs, Kievennar [13] points out inefficiencies in using wargaming at the comparison stage

of a planning process. First, inefficiencies in developing multiple COAs, discussed previously, are carried over and multiplied by the extensive effort needed to wargame each COA properly. Because wargaming must be fairly detailed to provide a useful evaluation, a great deal of time and effort will be spent running through COAs that will ultimately be discarded. Second, after evaluation, once a COA has been decided on, the wargaming process will be repeated to test revisions from previous versions of the COA and to ensure the COA is complete. Wargaming also serves to help planners in developing their synchronization matrix.

As a result, Kievennar [13] recommends that wargaming not be used to evaluate COAs but only after a COA is selected for the purpose of synchronization. Evaluation should be an iterative process, as discussed earlier, in which the COA is gradually refined by examining assumptions and likely outcomes and evaluating the COA against satisficing criteria. Wargaming is only possible after extensive development of the COA when specific actions have been laid out in time and space [47]. Thus, Kievennar suggests that wargaming be done only when the basic concept underlying the COA has been accepted. The purpose of wargaming is to refine the specific actions needed in the COA and to synchronize the plan in time in space so that actions are adequately coordinated. The process of wargaming itself might be more useful in establishing the synchronization of actions in the shared understanding of the commander and staff than products such as the synchronization matrix [47].

Emphasize critical thinking and evaluation

Critical thinking is extremely valuable to creativity and flexibility in problem solving, which are both key requirements of effective planning [14] [40]. Asking questions of their own plan and testing assumptions are things that expert problem solvers do [50] and training courses developed to teach individuals how to engage in critical thinking have proven beneficial in promoting more effective planning [43] [53]. Thus, critical thinking should be encouraged through training and be made an explicit part of the planning process. Various planning models have included critical processes, such as relevancy checks [46] and listing assumptions [14] [48]. Critical thinking should take place right from the start of a planning process and continue throughout as the plan is constantly questioned to identify assumptions and associated information needs [50].

More emphasis on experiential training

Although not part of the planning process per se, the training given staff officers nevertheless plays a significant role in how the process is actually performed and the quality of the outcomes. Experience is crucial to intuitive decision making as it provides the knowledge base used to recognize situations and retrieve relevant actions (e.g., [3] [16]). Training that focuses on teaching general rules or concepts often is not very successful in promoting good performance [3]. Thus, practical or experiential training is considered a better means to teach individuals the kind of knowledge that will facilitate intuitive reasoning. This is especially true for developing skills in situation assessment, detecting anomalies, and managing uncertainty and time pressure [3].

There are a number of specific training methods that can be used to enhance trainees' experience. Basically, any program that can increase task-relevant knowledge can aid intuitive reasoning, although training aimed at improving the speed, accuracy, and scope of situation assessment is also valuable [16]. Thus, practical training by solving relevant and realistic scenarios is often advanced as a key training method [3]. In this kind of training, individuals become familiar with contexts and problems while performing the key decisions required in operational settings. Training with scenarios can be supported by cognitive feedback in after-action reviews that point out problems or missed opportunities and provide some organization for learned knowledge. Similarly, cognitive methods, such as expert modeling and studying common decision failures, can help people gain more from experiential training [3].

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A prototype of an intuitive planning process

The proposed concepts identified in the previous section can form the basis of an abbreviated planning process based on the premises of intuitive decision making theory. This section presents a prototype of such a process. The prototype is not intended to be a complete planning process but, rather, to serve as a framework in which to consider how the proposed concepts might be synthesized. A true planning process must be worked out in greater detail and be empirically tested.

Prototype overview

The prototype process is illustrated in Figure 8. In general design, it appears similar to the OPP and MDMP but there are a number of significant differences. Perhaps the most dramatic difference between the prototype process and the OPP is the adoption of the intuitive decision making theory. As a result, the prototype process involves development of only a single COA. The COA being worked on can change – indeed, almost certainly will change – through the development process but the process focuses only on a single COA that is intended to meet satisficing criteria. Thus, the prototype process explicitly discards the comparison of multiple COAs.

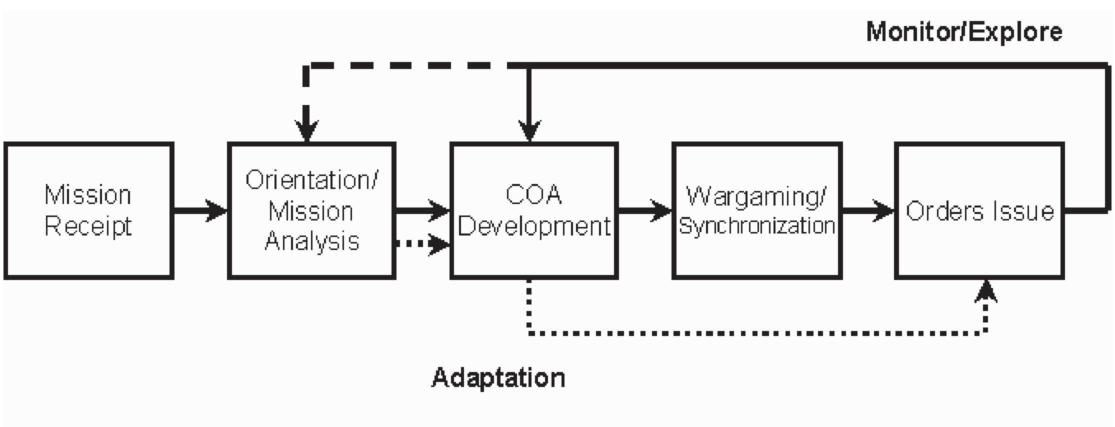

Figure 8. *A Prototype of an Abbreviated Intuitive Planning Process*

The prototype process begins, like the OPP, with the receipt of mission orders (or warning orders) and, also like the OPP, planning can begin before all information has been received. No changes are proposed to this stage. All of the subsequent steps are iterative; i.e. the planning team works with available information and revisits previous steps and sub-steps when new information becomes available. Orientation/Mission Analysis, for example, will likely require several cycles as more information about the mission and area of operations becomes available. COA Development also requires more than one cycle to refine a proposed option into an acceptable COA. Following Kievennar's suggestion, evaluation of the COA is done through critical analysis in the COA Development stage and Wargaming is used to operationalize and synchronize the COA so that it can be written in orders and propagated to

all subordinates. This is the final stage of Orders Issue, which like earlier stages can be revisited as changes in the plan necessitate new orders.

Orientation/mission analysis

Table 5 lists proposed sub-steps for each of the next three major steps in the proposed abbreviated process. The sub-steps are not intended to serve as a comprehensive breakdown of the steps but to provide a broad overview of the approach recommended for each step.

Orientation/Mission Analysis, in accord with the models of Kievennar [13] and Whitehurst [14], is viewed as the starting point for a COA. Most of the sub-steps in the current OPP translate to the abbreviated process as long as there is explicit focus on identifying the objectives of the mission and understanding the battlespace in a way that facilitates the commander's development of a base COA. Thus, there should be sub-steps that perform analyses of the goals/objectives of the mission and the assumptions being made to understand the battlespace. Whitehurst [14] also recommends that an explicit plan be developed for critiquing or critically evaluating the COA throughout the process. The critiquing plan is based especially on the assumptions analysis as all assumptions must be tested to confirm their validity.

Table 5: *Sub-Steps for Key Planning Stages*

Mission Analysis	COA Development	Wargaming/Synchronization
1. Situation Estimate	1. Develop Conceptual Model of Base COA (initial state, action sequence, desired end state)	1. Set-up (tools, materials, etc.)
2. Goal/Objective Analysis	2. Develop ECOA	2. Detail COA
3. Assumptions Analysis	3. Develop COA	3. Create Synchronization Matrix
4. Develop Critiquing Plan	4. Develop Contingency Plans	4. Rehearse (if time permits)
5. Identify Base COA (Commander)	5. Evaluate COA (coherence, applicability, completeness)	5. Simulate COA
	6. Evaluate COA (mental simulation/crystal ball/pre-mortem)	6. Revise Synchronization Matrix as needed
	7. Approve COA (Commander)	

COA development

COA Development is the step that is most changed from previous processes in the proposed abbreviated process. Because only a single COA is to be pursued, the focus of this step is on iteratively creating a COA, evaluating that COA, and redeveloping/redefining the COA to eliminate weaknesses and take advantage of opportunities.

Bryant [50] recommends representing the COA in the form of a "conceptual model," which is analogous to a situation model except that it is a representation of the battlespace as the commander *wants* it to be rather than actually is. In other words, the conceptual model represents the goals of the mission as well as a plan of action for achieving them. This model is more valuable when mission objectives are operationalized and represented as a particular desired end-state of the battlespace that can be objectively assessed. Likewise, representing the plan of action in terms of a series of transition states between the initial and desired end-state provides for more command-driven C2. Consequently, the first sub-step of COA Development (see Table 6) should be to operationalize the base COA developed previously by the commander to create an initial conceptual model in which to develop the COA. Having analysed the mission objectives in the previous step, the commander and staff are ready to describe these in concrete, observable terms.

As suggested by Whitehurst [14], the next sub-step is to develop an enemy COA, which the commander and staff use as a point of reference in developing the friend COA. Although the ECOA could be developed as part of Orientation/Mission Analysis, it is likely helpful in gaining a better understanding of the enemy to do this after the commander has developed the base COA and conceptual model because the friendly force's objectives will be a part of the enemy's thinking. Rather than viewing the enemy as an unthinking part of the environment, he should be considered as a proactive force that will attempt to anticipate what the friendly force will do.

With an ECOA in place, the base COA can be developed into a more complete COA. This is a highly iterative process in which the commander and staff work together, following the commander's conceptual model, to devise a solution path from the initial state of the battlespace to the desired end-state [13] [50]. This sub-step relies on the experience of the commander and staff to rapidly generate and evaluate solutions. As it is being developed, the COA should be evaluated in two ways, first with respect to its internal acceptability and, second, with respect to its capacity to accomplish mission objectives. In the first case, the commander and staff determine whether the COA meets criteria for coherence, applicability, and completeness, noting shortcomings so they can be corrected. In the latter case, the COA is compared to criteria for mission objectives to determine where it might fail to produce the desired effects. Again, deficiencies can be corrected as COA Development is iterated.

Wargaming/synchronization

Following Kievennar's [13] suggestion, wargaming in the proposed abbreviated process is a process of plan development; i.e. making the COA into a concrete, implementable plan. All evaluation of the COA is done prior to its acceptance, although the plan will always be open to revision when new information indicates the need. After preparatory activities, the COA is

recorded in greater detailing, moving from a concept to a plan. The commander and staff must visualize how the operation will be conducted – here the conceptual model is a valuable tool – and consider branches and sequels identified in COA Development. As the COA is refined, specific products like the Synchronization Matrix are developed as the basis for subsequent orders production. Figure 8 indicates a secondary arrow leading from COA Development to Orders Issue. This arrow represents changes to the plan after the operation has begun. If the plan must be adapted, there will be no time for wargaming and changes must go directly to Orders Issue.

Adaptation

A plan is not a static thing, especially in today's volatile environment. The plan must be considered a living document of the goals the commander wants to achieve and how, in general, he or she believes the goals will be obtained. Consequently, effort must be devoted throughout the operation to monitoring the battlespace for events or conditions that are inconsistent with the plan. When inconsistencies arise, the plan can be revised to deal with them.

Adaptation is illustrated in Figure 8 by arrows leading back from Orders Issue to COA Development and Orientation/Mission Analysis. These arrows represent adaptation of the plan as the operation progresses. The extent to which the plan is adapted depends on events in the battlespace. In most cases, adaptation will involve revisiting COA Development to make changes to objectives and the action sequence needed to achieve those objectives. In extreme cases, it may be necessary to re-conceptualize the mission itself should events indicate some major discrepancy between initial analysis and the actual state of the battlespace.

The previous analyses of objectives and assumptions are instrumental to adaptation. Because the conceptual model is goal-oriented, information gathering can be directed to identifying critical factors and asking critical questions. The conceptual model is used to formulate questions about the state of the battlespace in relation to the conceptual model, specifically about the ways in which the current situation is facilitating or thwarting the achievement of goals, the resources and actions that can alter the situation toward meeting goals, and the ways in which potential actions will likely affect the battlespace. These questions serve as key elements in directing information gathering to relevant aspects of the battlespace. Information gathering is then directed first and foremost to answering those questions.

Conclusion

This report has surveyed available literature pertaining to intuitive decision making and intuitive planning. From the literature, a number of lessons-learned have been drawn in the form of proposed intuitive planning concepts. Although empirical research is needed to validate the concepts identified, there seems to be promise in the synthesis of intuitive and analytic concepts of planning. The OPP serves as a well-documented and logical framework in which to conduct planning. Integrating intuitive concepts with the OPP may enhance the efficiency and effectiveness of planning in time-constrained and uncertain operational environments. The intuitive planning concepts identified in this report should serve as starting points for a new planning process.

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List of symbols/abbreviations/acronyms/initialisms

ATDM	Advance Team Decision Making
CF	Canadian Forces
CMBG	Canadian Mechanized Brigade Group
COA	Course of Action
CONOPS	Concept of Operations
COS	Chief of Staff
DSM	Decision Support Matrix
DST	Decision Support Template
ECOA	Enemy Course of Action
FCOA	Friend Course of Action
FFIR	Friendly Force Information Requirements
G3	General Staff 3
HPT	High-Payoff Target
HVT	High-Value Target
IDEAS	Identify, Deconflict, Evaluate, Act, Stop
IR	Information Requirement
LF	Land Force
MDMP	Military Decision Making Process
NDM	Naturalistic Decision Making
OPP	Operations Planning Process
PIR	Priority Intelligence Requirement
RPD	Recognition-Primed Decision
RPM	Recognition Planning Model
STEP	Story, Testing, Evaluation, Plan

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